
Designing a System with People in Mind — Human Systems Integration and the Deepwater Program

By Commander Mark Rutherford, USCG (Ret.), '81

Human systems integration (HSI) represents an acquisition approach whose premise is that new systems, fundamentally, are material solutions *made for people to use* to fulfill their organization's mission needs. This presupposition should seem reasonable, even obvious, to even the casual observer. Certainly none would argue, for example, that the current state of technology and automation allows the Coast Guard to build cutters that sail uninhabited around the globe in support of its multiple missions. Nor, on the aviation side, would any contend that even an "unmanned" aerial vehicle (UAV) is free of a human interface. Some of the thornier operational issues related to UAVs, in fact, involve precisely *how* humans will remain in the loop to control and support their operations.

The simple truth that systems are acquired for people to use is a primary driver in the design, development, and acquisition of the Coast Guard's Integrated Deepwater System (IDS). This focus on the customer — the fleet operator and, ultimately, the U.S. taxpayer — is reflected in the twin goals of the Deepwater program: to maximize operational effectiveness (OpEff) while minimizing total ownership cost (TOC).

Deepwater's OpEff objectives will be met through a complex, networked system composed of modern and highly capable cutters, aircraft, and systems for C4ISR (command, control, communications, computers, intelligence, surveillance, and reconnaissance) and integrated logistics support — all operated and maintained by *people* who will be the critical link in enabling the system to achieve its full operational potential. Because personnel-related costs constitute roughly two-thirds of the Coast Guard budget, TOC objectives for Deepwater can be achieved only by following a rigorous framework to ensure people-related expenses (e.g., crewing, training, etc.) are held to the lowest feasible level over the entire life cycle of the system and its platforms.

Striking the Right Balance

Thus, Deepwater's OpEff and TOC objectives lead to somewhat of a paradox when it comes to people. On the one hand, the fewer people in the system, the more financial resources are made available for platforms able to achieve the system's full

capability and capacity. On the other hand, the more capability and capacity built into this complex system as a result of personnel cost reductions, the more that the system's viability depends on its assets being fully operable and sustainable by smaller crew complements. The key challenge for Deepwater, then, is to find the most efficient and effective balance between people and assets. Getting out of balance on either side of the equation directly and adversely impacts Deepwater's TOC, system effectiveness, capability, capacity, and sustainability—in short, greatly complicating the achievement of Deepwater's twin goals.

Striking the right balance in a system of systems as complex as IDS can be achieved only through the consistent, systematic, and pervasive application of HSI principles in the Deepwater acquisition process. For this reason, HSI must be fundamental to how the Coast Guard and Integrated Coast Guard Systems (Deepwater's partner in industry) design, plan, and manage the program; it is the only approach that produces the most efficient asset crew sizes consistent with risk, affordability, human-performance capability, and human workload.¹

Ideally, HSI is introduced at the outset of the acquisition process in the *Mission Needs Statement* leading to Key Performance Parameters (KPPs — pass/fail criteria) that are incorporated in an *Operational Requirements* or *Initial Capability Document*. The earlier that HSI is applied within the systems-engineering process, the greater is the opportunity for HSI to influence system design to account fully for interdependent elements of manpower, personnel, training, human factors engineering (HFE), safety, habitability, health, and survivability. By designing the system with the human in

mind, the probability of successful system performance increases, and the probability of costly HSI-related "fixes" in the future decreases. Regarding the latter, downstream corrections to remediate the consequences of poor applications of HSI become progressively more costly the farther the system progresses through its life cycle.

Deepwater's National Security Cutter (NSC) provides an example of the need to harmonize HSI elements within the asset-design process. The NSC will be a highly capable and complex platform that is intended to accomplish a tremendously challenging mission set with an extraordinarily constrained crew size. If the reduced crew complement, which must be delicately balanced with ship configuration and mission, is to be truly capable of operating the NSC according to system expectations, then everything about the NSC design must facilitate human performance, and nothing in the design must present an obstacle.

Failure to couple a vigorous and influential HFE component, for example, with a reliable and verifiable manpower-determination component could spell failure for the program since the resultant sub-optimized asset and crew combination could



With more than two-thirds of the Coast Guard budget devoted to personnel-related costs, the Integrated Deepwater System's twin goals of maximizing operational effectiveness while minimizing total ownership costs can only be achieved by incorporating the principles of human systems integration into the design and acquisition of Deepwater's air and surface assets. Here, Boatswain's Mate First Class William Lappin (left), of Portland Me., and Seaman Ken Rose get underway from the U.S. Coast Guard Cutter Bainbridge Island while on patrol in New York Harbor last August. (USCG photo PA1 Tom Sperduto)

not fulfill its prescribed and essential role in IDS. This situation is exacerbated by the criticality of personnel and training elements since the NSC's operational effectiveness will depend upon the on-board availability of the right number of the right types of people with the right training who, in turn, have been matched against accurate workload projections and a thoroughly accommodating ship design.

HSI's important enabling role was recently underscored by Rear Adm. Patrick M. Stillman, Deepwater's program executive officer. "Optimal manning is fundamental to the success of Deepwater," he said. "There is only one way to get there — ruthless HSI."

An Organizational Imperative

In a recent General Accounting Office report (*Navy Actions Needed to Optimize Ship Crew Size and Reduce Total Ownership Costs*), the Navy was criticized for its inconsistency in systematically applying HSI to ship acquisitions. "Because the Navy did not consistently apply HSI principles and set goals for reducing crew size for three of the ships we reviewed," the GAO said, "it may have missed opportunities to reduce crewing requirements and lower total ownership costs, which are determined largely by decisions made early in the acquisition process, but will be incurred through these ships' 30-40 year life spans."

There are clear indications, however, that the Navy is embracing and institutionalizing HSI in its acquisitions programs as an organizational imperative. Adm. Vern Clark, the chief of naval operations (CNO), has asserted that HSI is the key to the Navy's

success in meeting profound post-9/11 challenges with constrained resources. In his *CNO Guidance for 2004*, for example, he said, "We will spend whatever it takes to equip and enable our Sailors, but we do not want to spend one extra penny for manpower we do not need." One goal stipulated in his 2004 *Guidance* states, "Further embed the Human Performance Systems Model into every Navy acquisition and R&D program." As part of the Navy's "Sea Warrior Task Force" (tasked to deliver the right skills to the right place at the right time), the Navy will apply all lessons learned from past optimal manning experiments — to include identifying the technical support and technology enablers that support development of a strategy for implementation throughout the force.

Moreover, the commander of the Naval Sea Systems Command (NAVSEA), Vice Adm. Phillip M. Balisle, has stated that HSI efforts within the Littoral Combat Ship, CVN-21 aircraft carrier, and DD(X) next-generation destroyer programs would "make or break these warfighting platforms of the future, both in how we operate them and how we maintain them." Vice Adm. Balisle spoke to the practical realities of applying HSI within acquisitions, stating that HSI "... must be established as a budget line item in all programs, not

buried in the murky word 'logistics.' Sailors are not logistics elements." It is significant that NAVSEA recently established an HSI Directorate ("SEA 03") to certify HSI compliance of ships and systems delivered to the Navy's fleet.

Like the CNO and NAVSEA, Deepwater Program Executive Officer Rear Adm. Patrick M. Stillman has declared his intentions to pursue robust HSI influence fervently in the Deepwater program — convinced that

"Deepwater will change the basic fundamental processes we use. How we assign, train, and deploy people as well as our doctrine, tactics, logistics and personnel policies will all materially change with Deepwater."
— Adm. Thomas H. Collins
Commandant of the Coast Guard

it is the only way to optimize the human component such that TOC is minimized through greater crew efficiencies and OpEff is realized through striking an effective balance between a lean crew composition and asset design and workload. Moving farther down this road will require a serious commitment—not only from the Deepwater program's Coast Guard-industry partnership (e.g., elevating HSI's organizational position, committing necessary resources, enhancing responsibility and authority, demonstrating programmatic commitment, and ensuring contractual reinforcement), but also from senior Coast Guard leadership.

In his recently reissued *Commandant's Direction*, Commandant Adm. Thomas H. Collins noted that Coast Guard people will operate in an increasingly more complex and technologically sophisticated environment. HSI figures significantly in the commandant's priority to increase the service's commitment to its people. The Coast Guard will, he said, "Design human resource-sensitive requirements into the acquisition of new hardware, the implementation of new policies driven by the changing security environment, and the design and deployment of new information technology systems."

The Deepwater program represents a new and exciting model for the Coast Guard to design and acquire a true system of systems suitable to sustain its operational excellence into the 21st century—one in which human systems integration must play an increasingly important role in enabling the program to achieve its twin goals of maximizing operational effectiveness at the lowest attainable total ownership cost.

End Notes

¹ Recognizing the essential value of HSI to major defense acquisitions, DOD has mandated this approach in two of its most recent acquisitions directives, both issued on 12 May 2003. DOD Directive 5000.1 ("The Defense Acquisition System") requires that acquisition program managers (PMs) employ a Total Systems Approach that includes "human systems integration to optimize total system performance (hardware, software, and human), operational effectiveness, and suitability,



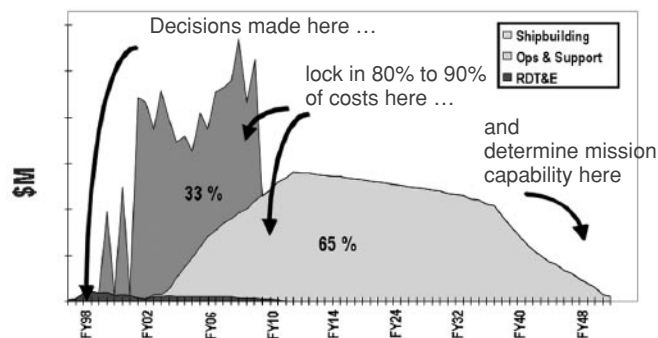
Commandant of the Coast Guard Adm. Thomas H. Collins (center) — shown here during a tour of the Coast Guard Cutter Tahoma's engine room by Petty Officer 1st Class Byron Belmas during a visit to Guantanamo Bay, Cuba, in 2003 — has directed the Coast Guard to design human resource-sensitive requirements into the acquisition of new hardware, the implementation of new policies driven by the changing security environment, and the design and deployment of new information technology systems. (U.S. Coast Guard photo)

survivability, safety, and affordability.” In addition, DOD Instruction 5000.2 (“Operation of the Defense Acquisition System”) has an entire enclosure that outlines HSI-related acquisition strategy requirements and requires that the PM “shall have a comprehensive plan for HSI in place early in the acquisition process to optimize total system performance, minimize total ownership costs, and ensure that the system is built to accommodate the characteristics of the user population that will operate, maintain, and support the system.”

About the Author

CDR Mark Rutherford (Ret), a 1981 graduate of the Coast Guard Academy, serves as the Integrated Deepwater System’s technical director for human systems integration at Coast Guard Headquarters in Washington, DC. He served aboard the *USCGC Durable* and commanded the cutters *Point Estero*, *Point Verde*, and *Vashon*. He joined the Deepwater HSI staff in 1999. He is a native of Mobile, AL.

Why Do Human Systems Integration?



**Early decisions drive Total Ownership Costs:
Design decisions drive HSI costs (40-60%)**

The U.S. Navy estimates that more than half of a ship's total ownership costs during its service life will result from personnel-related expenses. For this reason, Chief of Naval Operations Adm. Vern Clark recently directed that human systems integration will be embedded in every Navy acquisition and R&D program. (U.S. NAVY graphic)

Adding to the Heritage of CGA and CG Aviation

by Captain Ray Copin, (Ret), '54

Soon after Hurricane Isabel dumped on North Carolina, the weekend of October 10-12, 2003, brought several hundred modern day Pterodactyls, guests and friends to Elizabeth City. This annual gathering of The Ancient Order of the Pterodactyl, the Coast Guard aviation association, was hosted by the USCG Aircraft Repair and Support Center commanded by Captain Bruce Drahos, '78.

This 'roost,' as it is known, included many activities for participants. One highlight, in recognition of the first century of manned flight, was a bus caravan to the outer banks for a visit to the site of Orville and Wilbur's first flight and a nearby recently dedicated monument of pylons commemorating one hundred years of aviation. One of the pylons celebrates Coast Guard service and accomplishments during the century by floating, shore and aviation units and personnel. This pylon was funded by individual and corporate donations. Among the sponsors were the Foundation for Coast Guard History, Executive Director Captain Fred Herzberg, (Ret), '55 and the Ancient Order of the Pterodactyl, President Captain George Krietemeyer, (Ret), '59. Fund raising for the project was inspired and coordinated by VADM Howard Thorsen, (Ret), '55 and RADM Robert Johanson, (Ret), '55. When next you pass near the Cape Hatteras Light, don't miss visiting the Kittyhawk Century of Flight Monument as well as the nearby Kill Devil Hills national park.

Recognition of active duty performance is a regular feature of a banquet during the annual Pterodactyl 'roost.' Awards conceived and funded by the Ancient Order honor individuals and crews in several categories, Flight Safety, Fixed and Rotary Wing Rescue and Aviation Maintenance. Presenters

at Elizabeth City included RADM James Olson, '70, Captain Thomas King, '74, Captain Barry Harner, '75 and Commander Charles Strangfeld, '83. Award recipients are selected by the Commandant's staff for their outstanding performance. CWO Pete Fonticoba, CG Air Station Miami, received the aviation maintenance award for extraordinary work in support of a host of operational requirements. The **Captain Marion "Gus" Shrode Aviation Safety Award** went to LT Richard Bates, currently at CGAS Savannah, for his performance as safety department head, Helicopter Interdiction Tactical Squadron, Jacksonville, Florida. LCDR Evan Grant, LT Andrea Sacchetti and AMT2 Raymond Morris, CGAS North Bend, were recognized with the **Sikorsky Aircraft Corporation Frank Erickson Rotary Wing Rescue Award** for lifting an injured firefighter to safety under very difficult conditions. ACGAS Elizabeth City HC-130 crew was presented with the **Commander Elmer F. Stone Fixed Wing Rescue Award**. That life saving mission of LCDR Michael Callahan, LT Alan Hansen, '98, AMTC Howard Reed, AVT2 Philip Benton, AVT3 Beau Stough, AVT2 Bennet Durham, AMT3 Christopher Teall, AMT1 Thomas Baugh and AMT3 Wendy Musser involved a flight hundreds of miles offshore in very poor weather conditions and the successful aerial delivery of a life raft survival kit to a survivor which they had located on the surface of the Atlantic.

One other award was a surprise to John 'Bear' Moseley, '54, who received the **Commandant's Swivel Shot Award** for his successful efforts to obtain Internal Revenue Service recognition of the Ancient Order as a not for profit, tax exempt organization.

The Ancient Order of the Pterodactyl was initially organized in 1977 as an association of U.S. Coast Guard aircrews. Membership has grown steadily over the years to its present level of about twelve hundred and growing. The organization is totally volunteer driven, and the modest annual dues of fifteen dollars are tax deductible. In addition to sponsoring annual active duty maintenance, rescue and safety awards, the Order provides financial support to the Academy Cadet Aviation Club and various museums displaying and promoting CG aviation, projects such as the Century of Flight Monument at Kitty Hawk, N.C., and many other initiatives aimed at preserving Coast Guard history. Membership is open to any individual or organization interested in supporting The Ancient Order of the Pterodactyls which exists to support and promote the accomplishments and history of United States Coast Guard Aviation. For more information and an application for membership, write to AOP, P.O. Box 9917, Mobile, Alabama 36691-9917 or visit the website www.AOPtero.org.



MCPO Beardsley, RADM Olson, '70, Mr. Moseley, '54 and Capt Krietemeyer, '59 (Regrettably, space constraints preclude us from printing photos of all award recipients. Congratulations to all for their fine service to our Nation!)